

wherein a concentration of impurities in said BPSG film is 3.0 wt% for phosphorus and boron.

35. (New) A semiconductor device as set forth in Claim 1, further including a gate electrode formed on said semiconductor region,

wherein the thickness of said first insulating film is twice the thickness of said gate electrode.

36. (New) A semiconductor device as set forth in claim 1, wherein said third insulating film is formed directly on said second insulating film.

REMARKS

I. Introduction

In response to the pending Office Action, Applicants have amended claim 1 so as to address the pending rejection under 35 U.S.C. § 112, second paragraph, and to clearly define the intended subject matter of the present invention. No new matter has been added. In addition, new claims 34-36 have been added. Support for new claims 34-36 can be found on page 29, line 14 to page 30, line 2 of the specification.

It is noted that the pending Office Action did not expressly respond to the Applicants' traversal of the pending restriction requirement. Accordingly, while the non-elected claims have been withdrawn from consideration, as set forth in Applicants' previous response, it is respectfully submitted that claim 1 is generic to all pending claims, as claim 1 is the only pending independent claim. Accordingly, as it is

submitted that claim 1 is allowable for the reasons set forth below, all pending dependent claims should be considered in the instant application.

II. The Rejection Of The Claims Under 35 U.S.C. § 112, Second Paragraph

Claims 1, 4, 6, 7, 10, 12 and 13 were rejected under 35 U.S.C. § 112, second paragraph, for failing to distinctly point out and claim the subject matter of the invention.

In particular, it was stated that the phrase "a supporting film formed on at least one of the upper and lower surface of the second insulating film" is unclear. In response, Applicants have amended claim 1 so as to eliminate the foregoing language from claim 1, and replace it with the phrase "a supporting film formed between said first insulating film and said second insulating film". Referring to the embodiment illustrated in Fig. 1, the supporting film corresponds to the silicon oxide film 5, the first insulating film corresponds to the first BPSG film 3, and the second insulating film corresponds to the silicon nitride film 6. It is respectfully submitted that the amendment to claim 1 makes the subject matter in question clear and definite and readily understandable by those of skill in the art. As such, it is submitted that the pending rejection of claim 1 under 35 U.S.C. § 112, second paragraph.

III. The Rejection Of The Claims Under 35 U.S.C. § 103

Claims 1, 4, 6, 7, 10, 12 and 13 were rejected under 35 U.S.C. § 103 as being unpatentable over Lee. For the following reasons, Applicants respectfully submit that the pending claims are patentable over Lee.

As recited by amended claim 1, referring to the exemplary embodiment of Fig. 1,

the present invention relates to a semiconductor device comprising a substrate 1 having a semiconductor region; a first insulating film (BPSG film 3) formed on the substrate and having the property of reflowing due to subsequent heat treatments; a second insulating film containing silicon nitride (silicon nitride film 6); a third insulating film (second BPSG film 7) formed at a higher level than the first insulating film and having the property of reflowing as the result of heat treatments under predetermined conditions; and a supporting film (silicon oxide film 5) formed between the first insulating film and the second insulating film.

As explained in detail in the specification on pages 32 and 33, the supporting film 5, which is not reflowable, exerts a tensile stress on the silicon nitride film 6. This stress functions to prevent the formation of wrinkles or cracks in the silicon nitride film 6 when the first insulating film is reflowed as the result of subsequent heat treatments utilized, for example, to planarize subsequent layers. As a result, the structure of the present invention prevents cracks or wrinkles from being formed in the silicon nitride film 6.

Turning to the cited prior art, Lee discloses a semiconductor device including a substrate 100, a gate 70 formed on the substrate, a first insulating layer 125 (BPSG film), a second insulating layer (O_3 -TEOS film) 135 formed on the first insulating layer and a third insulating layer 136 formed on the second insulating layer.

As set forth in Lee, the object of the device disclosed therein is to reduce the difference in levels due to the gate electrode 70. Referring to Fig. 4c of Lee, the first insulating layer 125 is buried within the gate electrode 70 (i.e., the layer 125 does not extend above the top surface of the gate electrode 70), the second insulating layer 135 is formed over the first insulating layer 125 and the gate electrode 76, and functions as

an interlayer insulating layer. Finally, as stated, the third insulating layer 136 is formed on the second insulating layer 135.

In contrast to the present invention as recited by claim 1, at a minimum, Lee fails to disclose at least the following limitations. First, Lee fails to disclose or suggest a third insulating film formed at a ***higher level*** than the first insulating film, which has the ***property of reflowing*** due to heat treatment under predetermined conditions. ***Second, L e completely fails to disclose or suggest the claimed support film formed between the first insulating film and the second insulating film.*** As explained above, the claimed supporting film functions to prevent the second insulating film from cracking or wrinkling as a result of the first insulating film being subject to a reflow process.

More specifically, the second insulating layer 135 disclosed in Lee is formed as an interlayer insulating film. Lee fails to disclose a support film disposed between the first insulating film and the second insulating film having at least silicon nitride, which exerts a tensile strength on the second insulating film so as to prevent the second insulating film from cracking or wrinkling when the first insulating film is subjected to the reflow process. The purpose of the O₃-TEOS layer 135 of Lee is completely different than the claimed support layer. In addition, according to Lee, not only a BPSG film, but also an O₃-TEOS film, not having reflow properties, can be utilized as the first insulating film. Accordingly, the second insulating film 135 of Lee is not formed as a support film.

Accordingly, at a minimum, Lee fails to disclose or suggest the claimed third insulating film or the claimed supporting film recited by the claim 1 of the present

invention. As all claim limitations must be disclosed or suggested by the prior art in order to substantiate a rejection under 35 U.S.C. § 103 (see, M.P.E.P. § 2143), and the combination of cited prior art references does not disclose or suggest each limitation recited by amended claim 1, it is clear that claim 1 is not obvious in view of the cited prior art.

Further, it is also well known that the fact that the prior art could be modified so as to result in the combination defined by the claims at bar would not have made the modification obvious unless the prior art suggests the desirability of the modification. *In re Deminski*, 796 F.2d 436, 230 USPQ 313 (Fed. Cir. 1986).

Indeed, recognizing after the fact that such a modification would provide an improvement or advantage, without suggestion thereof by the prior art, rather than dictating a conclusion of obviousness, is an indication of improper application of hindsight considerations. Simplicity and hindsight are not proper criteria for resolving obviousness.

Reliance upon "general knowledge" (of what is known) to reject claims is not objective evidence that the claims as a whole, are obvious within the meaning of 35 U.S.C. § 103. In addition, mere conclusions that various aspects of the claimed invention are obvious does not support a *prima facie* case of obviousness under 35 U.S.C. § 103. In this regard, Applicants stress that what may be known in some general context does not necessarily render the claimed subject matter as a whole obvious within the meaning of 35 U.S.C. § 103.

For all of the foregoing reasons, it is respectfully submitted that claim1 is patentable over the cited prior art.

IV. All Dependent Claims Are Allowable Because The Independent Claim From Which They Depend Is Allowable

Under Federal Circuit guidelines, a dependent claim is nonobvious if the independent claim upon which it depends is allowable because all the limitations of the independent claim are contained in the dependent claims, *Hartness International Inc. v. Simplimatic Engineering Co.*, 819 F.2d at 1100, 1108 (Fed. Cir. 1987).

Accordingly, as claim 1 is patentable for the reasons set forth above, it is respectfully submitted that all pending dependent claims are also in condition for allowance.

Furthermore, the newly added dependent claims function to further distinguish the present invention over Lee. Specifically, new claim 34 recites that the concentration of impurities in the BPSG film is at least 3.0 wt% for phosphorus and boron. New claim 35 recites that the semiconductor device comprises a gate electrode and that first insulating film has a thickness twice that of the gate electrode. Clearly that is not the case in Lee, as the first insulating film 125 of Lee does not extend above the gate electrode 70. New claim 36 recites that the third insulating film 7 is formed directly on the second insulating film 6. Support for new claims 34-36 can be found on page 29, line 14 - page 30, line 2 of the specification. Additionally, claim 13 recites that the supporting film comprises a silicon oxide film. Clearly, the alleged corresponding support layer in Lee (O₃-TEOS layer 135) is not a silicon oxide film.

For all of the foregoing reasons, it is respectfully submitted that all dependent claims are allowable.

V. Previously Withdrawn Claim

It is noted that claims 2, 3, 5, 8, 9 and 11 were withdrawn from consideration by the Examiner as a result of Applicants response to the previously issued restriction requirement. As claim 1 is the only dependent claim and is allowable for the reasons set forth above, it is respectfully submitted that all other withdrawn dependent claims should be reinstated and allowed based on their dependency on claim 1.

VI. Request For Notice Of Allowance

Having fully responded to all matters raised in the Office Action, Applicants submit that all claims are in condition for allowance, an indication for which is respectfully solicited.


If there are any outstanding issues that might be resolved by an interview or an Examiner's amendment, the Examiner is requested to call Applicants' attorney at the telephone number shown below.

Respectfully submitted,

McDERMOTT, WILL & EMERY

Date: 12/21/01

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VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE TITLE:

The title of the invention has been amended to read as --A SEMICONDUCTOR DEVICE HAVING IMPROVED PLANARIZATION PROPERTIES AND A METHOD FOR FORMING THE SAME--.

IN THE CLAIMS:

Claims 2, 5 and 8 have been cancelled, without prejudice.

Claims 1 and 11 have been amended and new claims 34-36 have been added as follows:

1. (Amended) A semiconductor device comprising:
 - a substrate having a semiconductor region,
 - a first insulating film formed on said semiconductor region and having a property of reflowing due to a heat treatment under predetermined conditions,
 - a second insulating film formed on said first insulating film and containing at least silicon nitride,
 - a third insulating film formed at a higher level than said first insulating film and having a property of reflowing due to a heat treatment under said predetermined conditions, and
 - a supporting film formed [on at least one of the upper and lower surfaces of] between said first and second insulating [film] films for applying to said second insulating film a stress against deformation of said second insulating film caused by said heat treatment.

11. (Amended) A semiconductor device as set forth in Claim [3] 4,
wherein said storage node is a cylindrical storage node, and
wherein said supporting film comprises a TEOS film and serves as an etching
stopper film during the formation of the cylindrical storage node.

Please add new claims 34-36 as follows:

34. (New) A semiconductor device as set forth in Claim 12,
wherein a concentration of impurities in said BPSG film is 3.0 wt% for
phosphorus and boron.

35. (New) A semiconductor device as set forth in Claim 1, further including a
gate electrode formed on said semiconductor region,
wherein the thickness of said first insulating film is twice the thickness of said
gate electrode.

36. (New) A semiconductor device as set forth in claim 1, wherein said third
insulating film is formed directly on said second insulating film.